

5 Reconfiguration of a
 Group of Network Nodes
 in an Ad-hoc Network

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FIELD OF INVENTION

15 The present invention relates to a reconfiguration of a
group of network nodes in an ad-hoc network, and in
particular to a reconfiguration of a group of network nodes
in an ad-hoc network with particular emphasis on
reconfiguration consistency.

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BACKGROUND ART

25 Numerous factors associated with technology, business,
regulation and social behavior have driven the spreading of
wireless ad-hoc networking in the past, i.e., a wireless
network formed without any central administration. Ad-hoc
networks consist of a plurality of mobile devices using a
wireless interface for exchange of packet data. As each
mobile device in the ad-hoc network serves as router and
30 host, each such mobile device will forward data packets on

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behalf of other mobile devices and further run user applications. Therefore, in ad-hoc networks, mobile devices are connected directly for local cooperation.

5 To support on-going improvement of functionality, an ad-hoc network should provide the opportunity for a software update. It is often required that all mobile devices in such an ad-hoc network have the same software version, e.g., for reasons of compatibility. For this reason, the
10 software update should take place in a coordinated manner, preferably at the same point in time. In addition, either all mobile devices reconfigure successfully, or they all fall back to the software version before installation.

15 However, up to now no appropriate approach to the coordinated update of software in ad-hoc networks is available. Another issue not addressed so far is that during reconfiguration mobile devices may not communicate properly.

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SUMMARY OF INVENTION

In view of the above, the object of the present invention
25 is to provide a solution to consistent software reconfiguration in ad-hoc networks.

According to the present invention, this object is achieved through a method of reconfiguration for a network node,
30 e.g., a mobile device or a stationary device, in an ad-hoc network. The method comprises a first step of preparing a

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transition from an initial software configuration to a target software configuration and a second step to deciding on commitment to the target software configuration. According to the present invention, the decision on
5 commitment is taken in view of a result of reconfiguration indicated through at least one further network node in the ad-hoc network.

Therefore, according to the present invention, a transition
10 from an initial software configuration to a target software configuration is not executed anyway but such a transition is taken on the basis of information being related to reconfiguration at network nodes being reachable from the network node deciding on commitment to the target software
15 configuration.

In particular, if the information received is related to further reconfiguration processes in the further network nodes, it is possible to allow for coordination of
20 reconfiguration between different network nodes, although each single network node is operating autonomously.

In other words, according to the present invention it is proposed to not simply initiate an update process for
25 different network nodes in an ad-hoc network and to just hope that the reconfiguration will be successful, but to use feedback mechanisms locally in each single network node to decide on commitment to target software configurations.

30 According to a preferred embodiment of the invention it is proposed to negotiate a maximum reconfiguration time period

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CLAIMS

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1. Method of reconfiguration for a network node in an ad-hoc network, comprising the steps:

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preparing a transition from an initial software configuration to a target software configuration;

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deciding on commitment to the target software configuration in view of a result of reconfiguration indicated through at least one further network node in the ad-hoc network.

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2. Method according to claim 1, *characterized in that* it further comprises a step of negotiating a maximum reconfiguration time period with at least one further network node before executing the transition from the initial software configuration to the target software configuration.

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3. Method according to claim 2, *characterized in that* the maximum reconfiguration time period is the maximum time for reconfiguration, indication of reconfiguration result, and executing a fallback to the initial software configuration for network nodes in the ad-hoc network participating in the reconfiguration process.

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4. Method according to one of the claims 1 to 3,
characterized in that it further comprises a step of
coordinating a start of reconfiguration at the network
5 node with a start of reconfiguration in at least one
further network node.
5. Method according to one of the claims 2 to 4,
characterized in that it further comprises a step of
10 starting a timer in the network node for measurement
of actual reconfiguration time versus maximum
reconfiguration time period.
6. Method according to one of the claims 1 to 5,
15 *characterized in that* it further comprises a step of
determining network nodes being reachable from the
reconfigured network node when ad-hoc network
communication is interrupted during the transition
from the initial software configuration to the target
20 software configuration.
7. Method according to one of the claims 1 to 6,
characterized in that the step of committing to the
target software configuration is taken when every
25 result of reconfiguration received at the network node
from a reachable further network node is evaluated to
be positive.
8. Method according to one of the claims 1 to 6,
30 *characterized in that* it further comprises a step of
falling back to the initial software configuration

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when at least one result of reconfiguration received at the network node from a reachable further network node is evaluated to be negative.

- 5 9. Method according to one of the claims 1 to 6,
characterized in that it comprises a step of falling
back to the initial software configuration when no
result of reconfiguration result is received at the
network node until expiry of the maximum
10 reconfiguration time period.
10. Method according to one of the claims 1 to 9,
characterized in that it further comprises a step of
sending a positive reconfiguration result when the
15 transition from the initial software configuration to
the target software configuration is successful.
11. Method according to claim 10, *characterized in that*
the positive reconfiguration result is sent as
20 positive signal or indicated through automatic set-up
of network connectivity.
12. Method according to claim 10 or 11, *characterized in*
that the positive reconfiguration result is sent
25 repeatedly.
13. Method according to one of the claims 1 to 9,
characterized in that it further comprises a step of
sending a negative reconfiguration result when the
30 transition from the initial software configuration to
the target software configuration is not successful.

14. Method according to claim 13, *characterized in that* the negative reconfiguration result is sent as fallback signal.

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15. Method according to claim 13 or 14, *characterized in that* the negative reconfiguration result is sent repeatedly.

10 16. Method according to one of the claims 13 to 15, *characterized in that* it further comprises a step of forwarding results of reconfiguration received from further network nodes to the ad-hoc network.

15 17. Method according to one of the claims 1 to 16, *characterized in that* it further comprises a step of determining network nodes in the ad-hoc network executing reconfiguration.

20 18. Method according to claim 17, *characterized in that* the step of determining network nodes in the ad-hoc network executing reconfiguration is based on at least one criteria selected from a group comprising:

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- communication capability of network node;
 - network connectivity;
 - profile data of network node;
 - movement pattern of network node;
 - hardware status of network node;

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 - priority of network node; and
 - group membership of network node.

19. Method according to claim 17 or 18, *characterized in that* the step of determining network nodes in the ad-hoc network executing reconfiguration is executed before start of reconfiguration.
20. Method according to one of the claims 17 to 19, *characterized in that* the step of determining network nodes in the ad-hoc network executing reconfiguration is repeated during reconfiguration.
21. Method according to one of the claims 1 to 20, *characterized in that* it further comprises a step of retrieving software for executing the transition from the initial software configuration to the target software configuration locally from a portable electronic device (IC/USIM).
22. Method according to one of the claims 1 to 21, *characterized in that* it further comprises a step of retrieving software for executing the transition from the initial software configuration to the target software configuration remotely via a mobile communication environment.
23. Method according to claim 22, *characterized in that* it further comprises a step of selecting the mobile communication environment from a group comprising a mobile communication network, wireless local area network, personal area network, wireless infrared

communication network (IrDA), Bluetooth communication network.

24. Method according to claim 22, *characterized in that* it
5 further comprises a step of selecting the mobile communication network from a group comprising GSM, PDC, IMT 2000, PHS, IS-95.
25. Method according to one of the claims 21 to 24,
10 *characterized in that* it further comprises a step of pre-installing software for executing the transition from the initial software configuration to the target software configuration in the network node.
- 15 26. Method according to one of the claims 21 to 25, *characterized in that* it further comprises a step of selecting software for executing the transition from the initial software configuration to the target
20 software configuration from a group comprising application software, communication software, operating system software, firmware.
27. Method according to claim 26, *characterized in that* it
25 further comprises a step of retrieving software for executing the transition from the initial software configuration to the target software configuration in combination with related control parameters.
28. Method according to one of the claims 1 to 27,
30 *characterized in that* software for executing the transition from the initial software configuration to

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the target software configuration is network node specific.

29. Method according to one of the claims 1 to 28,
characterized in that the network node is a mobile
device or a stationary device.

30. Network node for operation in an ad-hoc network,
comprising:

a software reconfiguration unit adapted to prepare a
transition from an initial software configuration to a
target software configuration;

a reconfiguration commitment unit adapted to decide on
commitment to the target software configuration in
view of a result of reconfiguration indicated through
at least one further network node in the ad-hoc
network.

31. Network node according to claim 30, *characterized in
that* it further comprises a negotiating unit adapted
to negotiate a maximum reconfiguration time period
with the at least one further network node before
executing the transition from the initial software
configuration to the target software configuration.

32. Network node according to claim 31, *characterized in
that* the negotiation unit is adapted to negotiate the
maximum reconfiguration time period as the maximum
time for reconfiguration, indication of

reconfiguration result, and executing a fallback to the initial software configuration for network nodes in the ad-hoc network participating in the reconfiguration process.

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33. Network node according to one of the claims 30 to 32, *characterized in that* it further comprises a reconfiguration coordination unit adapted to coordinate a start of reconfiguration at the network node with a start of reconfiguration in the at least one further network node.

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34. Network node according to one of the claims 31 or 33, *characterized in that* it further comprises a timer unit adapted to measure an actual reconfiguration time versus the maximum reconfiguration time period.

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35. Network node according to one of the claims 30 to 34, *characterized in that* it further comprises a connectivity unit adapted to determine network nodes being reachable from the reconfigured network node when ad-hoc network communication is interrupted during the transition from the initial software configuration to the target software configuration.

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36. Network node according to one of the claims 30 to 34, *characterized in that* the reconfiguration commitment unit is adapted to commit to the target software configuration when every result of reconfiguration received at the network node from a reachable further network node is evaluated to be positive.

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37. Network node according to one of the claims 30 to 34,
characterized in that the reconfiguration commitment
unit is adapted to decide on falling back to the
5 initial software configuration when at least one
result of reconfiguration received at the network node
from a reachable further network node is evaluated to
be negative.
- 10 38. Network node according to one of the claims 30 to 34,
characterized in that the reconfiguration commitment
unit is adapted to decide on falling back to the
initial software configuration when no result of
reconfiguration result is received at the network node
15 until expiry of the maximum reconfiguration time
period.
39. Network node according to one of the claims 30 to 38,
characterized in that it further comprises a
20 communication unit adapted to send a positive
reconfiguration result when the transition from the
initial software configuration to the target software
configuration is successful.
- 25 40. Network node according to claim 39, *characterized in*
that the communication unit is adapted to send the
positive reconfiguration result as positive signal or
adapted to indicate the positive reconfiguration
result through automatic set-up of network
30 connectivity.

41. Network node according to claim 39 or 40,
characterized in that the communication unit is
adapted to send the positive reconfiguration result
repeatedly.
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42. Network node according to one of the claims 30 to 38,
characterized in that it further comprises a
communication unit adapted to send a negative
reconfiguration result when the transition from the
10 initial software configuration to the target software
configuration is not successful.
43. Network node according to claim 42, *characterized in
that* communication unit is adapted to send the
15 negative reconfiguration result as fallback signal.
44. Network node according to claim 42 or 43,
characterized in that communication unit is adapted to
send the negative reconfiguration result repeatedly.
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45. Network node according to one of the claims 39 to 44,
characterized in that the communication unit is
further adapted to forward results of reconfiguration
received from further network nodes to the ad-hoc
25 network.
46. Network node according to one of the claims 30 to 45,
characterized in that it further comprises a
determination unit adapted to determine network nodes
30 in the ad-hoc network executing reconfiguration.

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47. Network node according to claim 46, *characterized in that* the determination unit is adapted to determine network nodes in the ad-hoc network executing reconfiguration based on at least one criteria selected from a group comprising:

- communication capability of network node;
- network connectivity;
- profile data of network node;
- movement pattern of network node;
- hardware status of network node;
- priority of network node; and
- group membership of network node.

48. Network node according to claim 46 or 47, *characterized in that* the determination unit is adapted to determine network nodes in the ad-hoc network executing reconfiguration before start of reconfiguration.

49. Network node according to one of the claims 46 to 48, *characterized in that* the determination unit is adapted to determine network nodes in the ad-hoc network executing reconfiguration repeatedly during reconfiguration.

50. Network node according to one of the claims 30 to 49, *characterized in that* it further comprises a software retrieval unit adapted to retrieve software for executing the transition from the initial software

configuration to the target software configuration locally from a portable electronic device .

51. Network node according to one of the claims 30 to 50,
5 *characterized in that* the software retrieval unit is further adapted to retrieve software for executing the transition from the initial software configuration to the target software configuration remotely via a mobile communication environment.

10 52. Network node according to claim 51, *characterized in that* the software retrieval unit is adapted to select the mobile communication environment from a group comprising a mobile communication network, wireless
15 local area network, personal area network, wireless infrared communication network (IrDA), Bluetooth communication network.

20 53. Network node according to claim 52, *characterized in that* the software retrieval unit is further adapted to select the mobile communication network from a group comprising GSM, PDC, IMT 2000, PHS, IS-95.

25 54. Network node according to one of the claims 49 to 53, *characterized in that* it further comprises a software storage unit adapted to store software for executing the transition from the initial software configuration to the target software configuration in the network node, the software being selected from a group
30 comprising application software, communication software, operating system software, firmware.

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55. Network node according to claim 54, *characterized in that* the software storage unit is further adapted to store software for executing the transition from the initial software configuration to the target software configuration in combination with related control parameters.
56. Network node according to one of the claims 30 to 55, *characterized in that* it is a mobile device or a stationary device.
57. A computer program product directly loadable into the internal memory of a network node of an ad-hoc network, comprising software code portions for performing the steps of one of the claims 1 to 29, when the product is run on a processor of the network node.

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